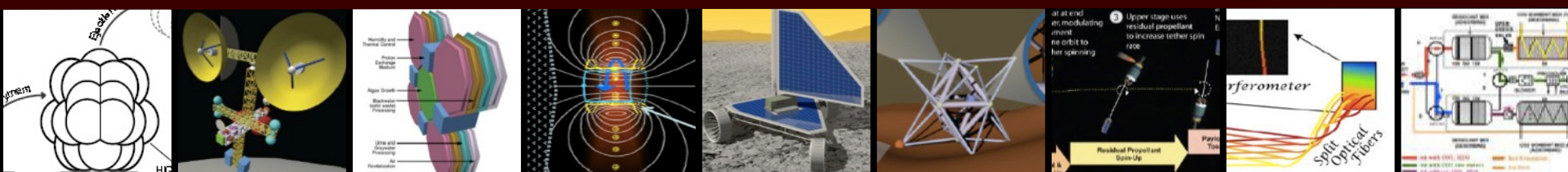


NASA INNOVATIVE ADVANCED CONCEPTS

2013 NIAC SPRING SYMPOSIUM

March 12-14, 2013 - Hyatt Regency McCormick Place - Chicago, Illinois

Dr. Jay Falker, NIAC Program Executive
Space Technology Mission Directorate - NASA Headquarters



Day 1 Outline



9:00 Commence

- **Welcome & Overview**
- **Keynote Address: *Jorge Arinez, General Motors***
- **Phase II Poster Overview**

10:45 – 11:00 Break

- **Two Phase I Presentations**

12:00 – 1:30 Lunch

- **Special Address: *Bryan Wunar, Museum of Science & Industry***
- **Two Phase I Presentations**

3:00 – 3:30 Break

- **Three Phase I Presentations**
- **Poster Session I**

5:30 Adjourn

Day 2 Outline



9:00 Commence

- **NIAC Plans & Announcements**
- **Special Address: *Bob Cassanova, NIAC External Council***

10:00 – 10:30 Break

- **Two Phase I Presentations**
- **Special Address: *Geza Gyuk, Adler Planetarium***
- **Special Address: *Kazuhiko Yotsumoto, JAXA Innovation Study Team***

12:00 – 1:30 Lunch

- **Two Phase I Presentations**

2:30 – 3:00 Break

- **Three Phase I Presentations**
- **4:30 Poster Session II & Ad Hoc Discussions**

5:30 Adjourn

Day 3 Outline



9:00 Commence

- **Q&A for NIAC Phase II and Other Topics**
- **Two Phase I Presentations**

10:30 – 10:45 Break

- **Two Phase I Presentations**

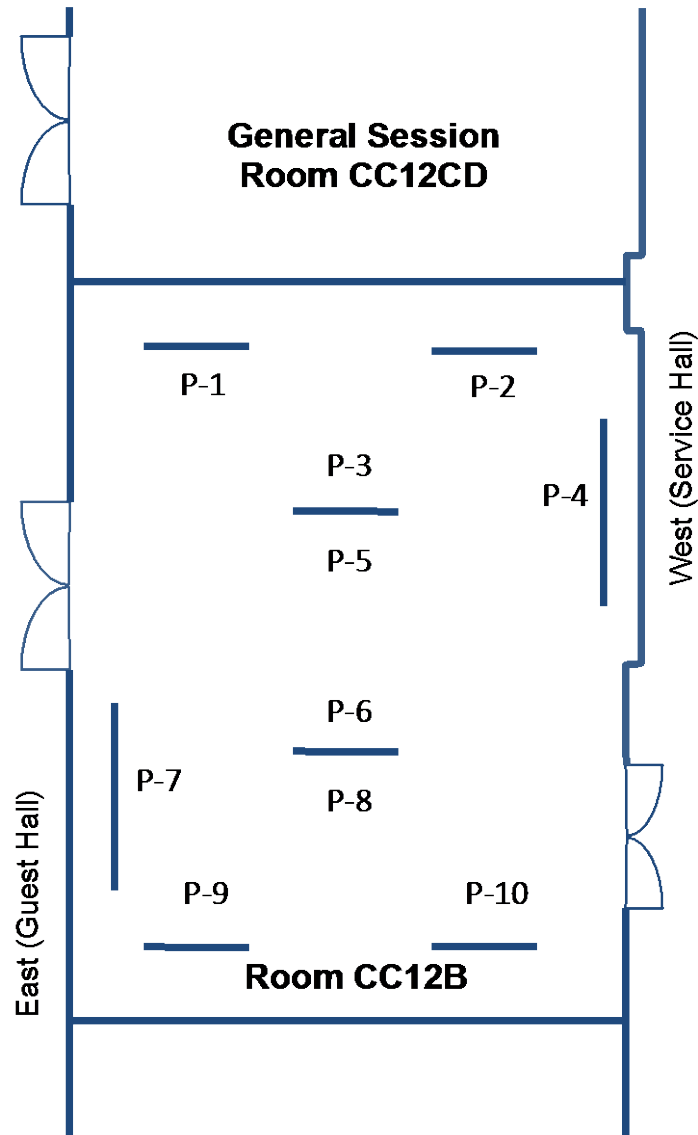
12:00 Adjourn – Spring Symposium Complete

12:00 – 5:00 NIAC External Council Meeting (Private)

Phase II Poster Sessions



- P-1 Duda, Kevin**
Variable Vector Countermeasure Suit (V2Suit) for Space Habitation and Exploration
- P-2 Short, Kendra**
Printable Spacecraft: Flexible Electronic Platforms for NASA Missions
- P-3 Khoshnevis, Behrokh**
ISRU-Based Robotic Construction Technologies for Lunar and Martian Infrastructures
- P-4 Whittaker, William**
Cavehopping Exploration of Planetary Skylights and Tunnels
- P-5 Strekalov, Dmitry**
Ghost Imaging of Space Objects
- P-6 Westover, Shayne**
Radiation Protection and Architecture Utilizing High Temperature Superconducting Magnets
- P-7 Miller, David**
High-Temperature Superconductors as Electromagnetic Deployment and Support Structures
- P-8 Slough, John**
The Fusion Driven Rocket: Nuclear Propulsion through Direct Conversion of Fusion Energy
- P-9 Ritter, Joe**
OCCAMS: Optically Controlled and Corrected Active Meta-material Space Structures
- P-10 Wie, Bong**
An Innovative Solution to NASA's NEO Impact Threat Mitigation Grand Challenge and Flight Validation Mission Architecture Development





WELCOME & OVERVIEW



www.nasa.gov/niac

“WALKING ON AIR”

<http://www.npr.org/blogs/thetwo-way/2012/04/23/151208875/video-space-out-with-nasas-walking-on-air>



What is **NIAC**?

NASA Innovative Advanced Concepts

NASA Innovative Advanced Concepts

A program to support
early studies of
innovative, yet credible,
visionary concepts
that could one day
“change the possible”
in aerospace.



Space Technology Programs



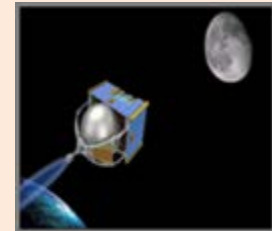
Transformative &
Crosscutting
Technology
Breakthroughs



**Game Changing
Development Program**



**Technology
Demonstration
Missions Program**



**Small Spacecraft
Technologies Program**

Pioneering Concepts/
Developing
Innovation
Community



**Space Technology
Research Grant Program**



**NASA Innovative
Advanced Concepts
(NIAC) Program**



**Center Innovation Fund
Program**

Creating Markets &
Growing Innovation
Economy



**Centennial Challenges
Prize Program**



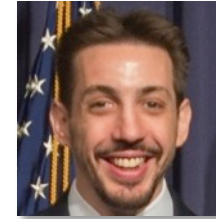
**Small Business Innovation Research
& Small Business Technology
Transfer (SBIR/STTR) Program**



**Flight Opportunities
Program**

NIAC Program Personnel

- Program Executive: **Jay Falker***
- Program Manager: **Jason Derleth***
- Senior Science Advisor: **Ron Turner**
- Outreach Coordinator: **Kathy Reilly**
- Financial Analyst: **Anita Babb-Bascomb***



* NASA Civil Servants

- NIAC External Council Chair: **Bob Cassanova**

Director of the original NIAC from 1998-2007



"Don't let your preoccupation with reality stifle your imagination"



BOAT ROCKERS, REBELS, RISK TAKERS, DEVIATORS
FROM THE NORM, INNOVATORS, CHAMPIONS,
REVOLUTIONARIES, MOVERS & SHAKERS,
INVENTORS, RABBLE ROUSERS, FLY IN THE FACERS,
REFORMERS, WAVE MAKERS, BOUNDARY PUSHERS &
OUT OF THE BOX THINKERS...



2012 NIAC Studies: 5 Group Overview



Revolutionary Construction

SpiderFab
Orbiting Rainbows
ISRU Robotic Construction
E-M Deployment/Structures
OCCAMS
Printable Spacecraft

Human Systems

Water Walls
Solid State Air Purification
V2Suit
Magnetic Radiation Protection

Sensing/Imaging

HOMES
NIST in Space
Atom Interferometry
Ghost Imaging

Autonomous Exploration

Super Ball Bot
RAP
Regolith Biters
Venus Landsailing Rover
EUROPA
Cavehopping Planetary Tunnels
Extreme Environmt. Sample Return

Transportation/NEO Mitigation

NanoTHOR
Plasma Aerocapture & Entry System
SSEARS
MAGNETOUR
Bi-Directional Flying Wing
Fusion Driven Rocket
NEO Impact Threat Mitigation

*Blue denotes Phase II Studies



NIAC

Program Details



Wait! Are we all wasting our time?

- *No, the sky **isn't** falling!*
- Facts:
 - Sequestration did hit (reducing govt funds)
 - NASA still doesn't have an FY13 budget
- But also:
 - NIAC wasn't cancelled
 - Solicitations weren't closed or postponed
 - Studies weren't cancelled or deferred
 - This Symposium wasn't even affected
- In short, we're very fortunate: no impacts yet
 - Future award numbers are TBD (but that's true every year)

NIAC Awards, Scope, Criteria

- NIAC awards support 2 phases of study:
 - **Phase I:** up to \$100K, ~9 months, for concept definition and initial analysis in a mission context
 - **Phase II:** up to \$500K, 2 years, for further development of most promising Phase I concepts, comparative mission analysis, pathways forward
- Scope of NIAC Phase I Studies:
 - Aerospace **architecture, mission, or system** concepts (not focused tech.)
 - **Exciting:** offering a potential breakthrough or revolutionary improvement
 - **Unexplored:** novel, with basic feasibility and properties unclear
 - **Credible:** sound scientific/engineering basis and plausible implementation
- NIAC proposal evaluation criteria:
 - **Potential of the Concept** (all scope elements above, especially exciting)
 - **Strength of the Approach** (research objectives, technical issues, suitability of team and cost)
 - **Benefits of the Study** (concept definition, mission analysis, wider benefits, scientific/engineering contributions, notably new/different/inspiring)

Three Stages of Reaction to Revolutionary Ideas

- 1 – It's completely impossible
- 2 – It's possible, but it's not worth doing
- 3 – I said it was a good idea all along

Arthur C. Clarke

Outreach

We encourage communication and sharing

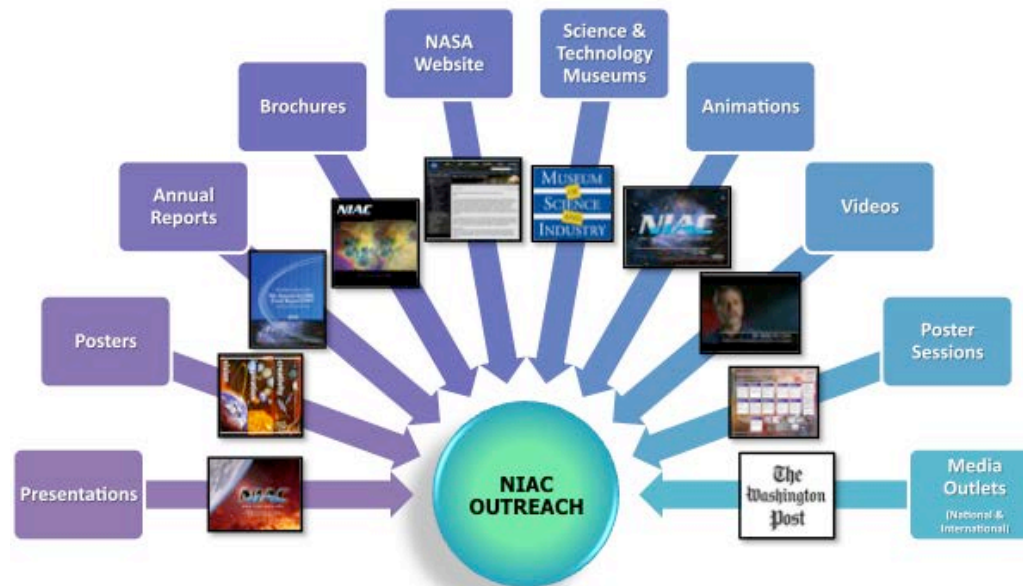
Between Fellows and with NASA, public, press, and other orgs

Your Spring presentation and Final Report will be **public**

Posted in pdf format on the NIAC website

Sensitive information can be protected (e.g., separate appendix)

Chicago Museum of Science & Industry, NIAC Education & Public Outreach Initiative: “From Science Fiction to Science Fact” Lecture Series



NIAC In The News

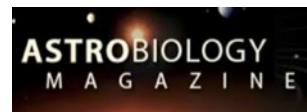
Media Coverage In Hundreds of Articles Since First Awards Announcement (08/08/11)



NewScientist



ADVANCING SCIENCE. SERVING SOCIETY



NATIONAL
INSTITUTE OF
AEROSPACE



PENN STATE



SPACE POLICY ONLINE



U.S. Politics Today

AN EIN NEWS SERVICE FOR POLITICAL PROFESSIONALS



Orlando Sentinel

Iowa State University
College of Engineering





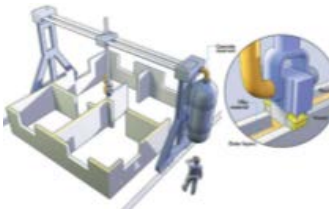



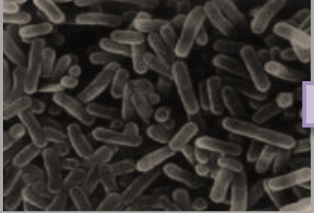


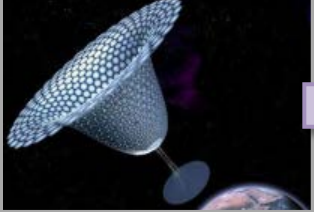





NIAC Studies Get Noticed

- **Please be sure to credit NASA and NIAC in all articles or products associated with your NIAC studies**
 - Include the logos if possible (downloadable from our website)
 - Mention your NIAC award as funding/contributing to your effort
- **Please notify Kathy Reilly of any publicity activities**
 - Just to be aware (never to interfere)
 - We can help point others to your work
- **You may be offered an article or short radio spot about your NIAC study**
 - Leonard David (journalist for Space.com, Space News, AIAA Aerospace America) is increasing awareness about STMD projects
 - Tim Allen, Communications Manager for the *Innovation Now* radio program, is interested in featuring NIAC studies
 - These opportunities are purely optional





Inspiring Wider Benefits

		3-D Printing the Home of the Future Emergency Construction for natural disasters, eradicate slums in developing countries	
		Improving Health With Spacesuit Technology Medical rehabilitation and physical therapy for individuals affected by stroke, spinal cord injuries, brain injuries, and the elderly.	
		Bacterial Batteries Novel Energy Source: Bacterial Microbes to power up robots	
		Space-Based Solar Power Power transmission to Earth for use during power outages, after natural disasters, to those in remote areas or by the military.	
		Navigation Gravitational waves on the atomic level could lead to technology for better steering of military submarines or aircraft	

Annual NIAC Opportunities



Phase I Solicitation

Open to everyone (US)
Date: early Jan. 2013



Phase II Solicitation

Eligible upon Phase I completion
Date: late May 2013



NIAC Spring Symposium

Open to everyone
Date: March 2013



NIAC Fall Symposium

Open to everyone
Date: November 2013



Open access to presentations/studies at:
www.nasa.gov/niac



KEYNOTE ADDRESS

JORGE ARINEZ

**General Motors
Global Research & Development**

**“Strategy and Innovation at GM
Manufacturing Research”**



www.nasa.gov/niac



Poster Overview

NIAC 2012 Phase II Fellows



Variable Vector Countermeasure Suit (V2Suit) for Space Habitation and Exploration

K. R. Duda¹, D. J. Newman², S.E. Jacobs³, R. Vasquez^{1,2}, and A. J. Middleton¹

¹Draper Laboratory, ²Massachusetts Institute of Technology, ³David Clark Company, Inc.

kduda@draper.com | (617) 258-4385

THE V2SUIT CONCEPT

The V2Suit is a spaceflight physiological adaptation countermeasure platform using gyroscopic motion to provide “viscous resistance” during body movements

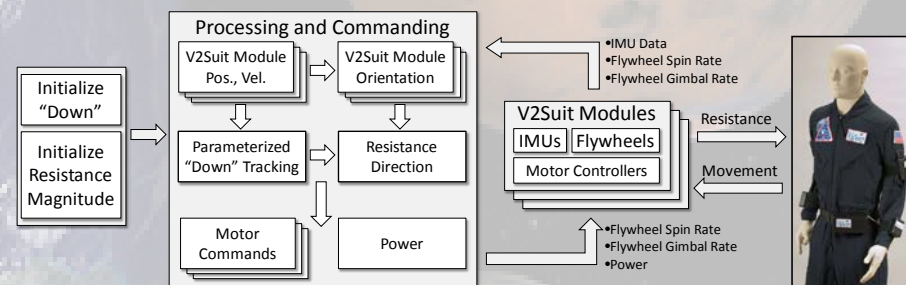


Wearable control moment gyroscopes that act in a coordinated manner to provide a resistance when movements are parallel to specified direction of “down.”

APPROACH

Integrated analysis and development to further the V2Suit concept – a goal of operational demo

- “Down” and Movement Tracking
- CMG architecture and control



AEROSPACE IMPACT

SPACE TECHNOLOGY WITH EARTH APPLICATIONS

An integrated and comprehensive countermeasure system has a measurable impact :

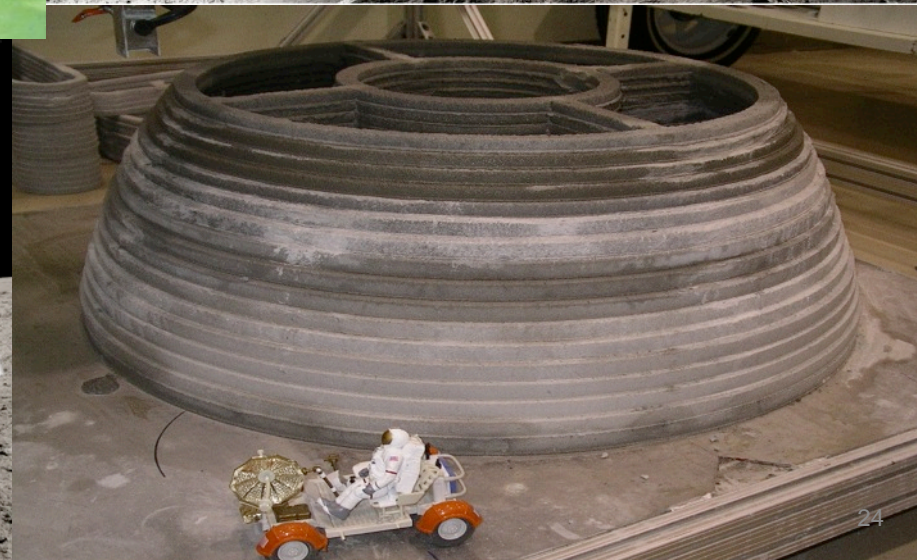
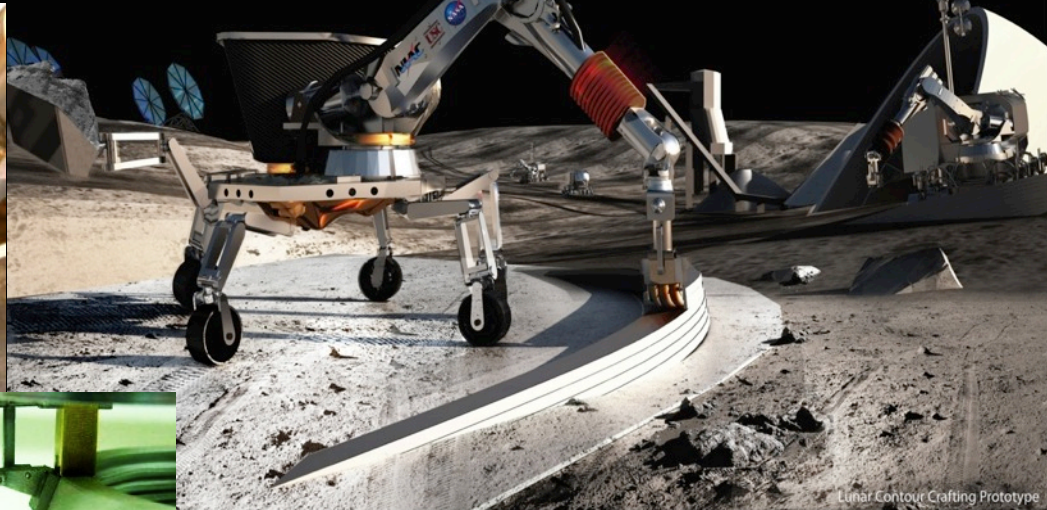
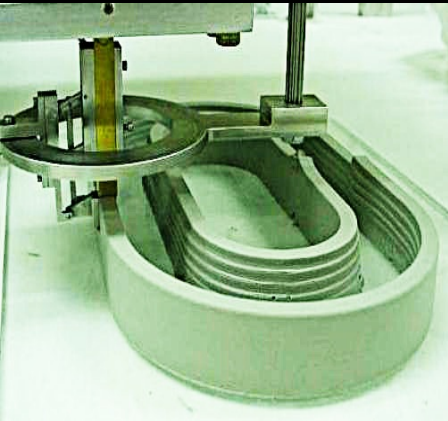
- Exercise equipment mass and volume
- Enable optimal performance during mission- specific gravitational transitions (landing, egress)

ISRU-BASED ROBOTIC CONSTRUCTION TECHNOLOGIES FOR LUNAR AND MARTIAN INFRASTRUCTURES



USC University of
Southern California

B. Khoshnevis
University of Southern California



High-Temperature Superconductors as Electromagnetic Deployment and Support Structures

David Miller, Massachusetts Institute of Technology

Description

In our NIAC Phase I study, awarded September 2011, the MIT Space Systems Lab (MIT SSL) began investigating a new structural and mechanical technique aimed at reducing the mass and increasing the stowed-to-deployed ratio of spacecraft systems. This technique uses the magnetic fields from current passing through coils of high-temperature superconductors (HTSs) to support spacecraft structures and deploy them to operational configurations from their positions as stowed inside a launch vehicle fairing. The chief limiting factor in spacecraft design today is the prohibitively large launch cost per unit mass. Therefore, the reduction of spacecraft mass has been a primary design driver for the last several decades. The traditional approach to the reduction of spacecraft mass is the optimization of actuators and structures to use the minimum material required for support, deployment, and interconnection. Isogrid panels, aluminum or composites, and gas-filled inflatable beams all reduce the mass of material necessary to build a truss or otherwise apply surface forces to a spacecraft structure. We instead look at using electromagnetic body forces generated by HTSs to reduce the need for material, load bearing support, and standoffs on spacecraft by maintaining spacing, stability, and position of elements with respect to one another.

HIGH-TEMPERATURE SUPERCONDUCTORS AS ELECTROMAGNETIC DEPLOYMENT AND SUPPORT STRUCTURES IN SPACECRAFT

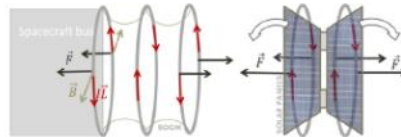
Header image credit: SuperPower Inc.

Problem Statement:

Creation of large-scale on-orbit spacecraft is limited by the need for the stowed configuration to fit in a launch vehicle fairing

Technology Description:

Electromagnetic forces generated by high-temperature superconducting (HTS) coils on each other are used to deploy, actuate, and support spacecraft structures instead of traditional structures and mechanisms like trusses, panels, and motors



Enabling Technologies for HTS Structures:

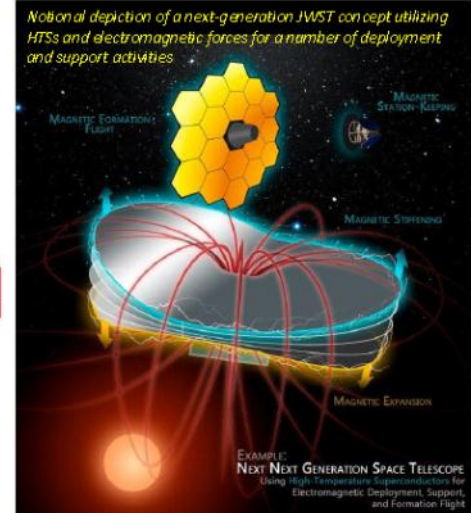
1. Rigid HTS coil
2. Flexible cryogenic heatpipe
3. Rigid cryogenic heatpipe
4. Flexible HTS coil

Potential Impacts to Spacecraft Industry:

1. Reduced spacecraft structural mass
2. Larger structures possible w/existing launch vehicles
3. Vibration- and thermally-isolated structures enabled
4. Staged deployment, in-space assembly, and partial system replacements
5. Reconfiguration of structures after deployment

Phase II Objectives:

1. Evaluate feasibility roadblocks to technology integration,
2. Refine models started in Phase I study,
3. Reduce risk and validate modeling via hardware proof-of-concepts of key technologies and enabling physical mechanisms,
4. and assess utility for candidate applications versus other structural technologies, with particular focus on the current design of the James Webb Space Telescope (JWST)



Cost: \$500K total, Schedule: 2 years

- Y1: Feasibility analysis and modeling
- Y2: Hardware experimentation, model calibration, and JWST case study

Roles:

- MIT(PI): modeling & rigid coil deployment
- UMD (Co-I): cryogenic heat pipe
- NASA GSFC (Collab): JWST integration analysis

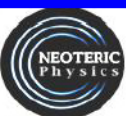
OCCAMS: Optically Controlled and Corrected Active Meta-material Space Structures

Joe Ritter, Neoteric Physics, Inc.




Description

This novel innovative advanced technology will enable innovative missions for imaging the cosmos, resolving spectral and spatial details of exosolar planets and searching for life, including evidence of Earth's origins, while substantially reducing mass, launch and fabrication costs for space telemetry. We seek an interim goal within 10 years of a Hubble size (2.4m) primary mirror weighing 1 pound at a cost of 10K in materials. The mandrel would be reusable for mass production, and the control system is on the order of \$20K of off the shelf components (for a ground test version). The potential cost savings are revolutionary. Inexpensive 6 meter class telescopes are a near term goal which would revive missions like the Space interferometry mission and save taxpayers \$billions while relieving NASA budget issues.



OCCAMS: Optically Controlled & Corrected Active Meta-material Space Structures

(Ultra-Lightweight Photonic Muscle Space Structures, Phase II)





Neoteric nano-engineering technology:
Tech to produce diffraction limited ultra-low mass space telescope mirrors via photonic elastomer transduction
Mirror shape is controlled by a beam of light from a single small laser!
Key technology to:

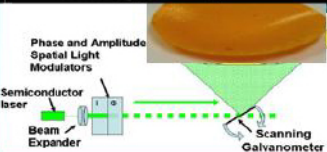
- Reduce Telescope mirror costs by 500x
- Enable 10-30x higher resolution systems
- Reduce areal density of Mirrors by 250x and Spacecraft bus&launch mass by 100x
- Mitigate development and deployment risk
- A Hubble size active mirror that weighs 1 pound made out of \$10k of chemicals? YES!

The Advance:

- Optically powered motion
- Optically controllable
- Memory material
- Control mirror with a single polarized beam!

Demonstrated Wavefront Control



Phase and Amplitude Spatial Light Modulators
Semiconductor laser
Beam Expander
Scanning Galvanometer

JWST Primary Mirror Comparison

Spec	JWST	OCCAM	Improvement
Areal Density	25Kg/m ²	0.1Kg/m ²	250x
Mirror Cost/m²	>\$26M	<\$0.05M	>500x
Diameter	6.5m	20-40m	3-6x

Ultra-lightweight Photonic Muscle Space Telescope

OCCAM: Optically Controlled & Corrected Active Mirror

NIAC

Joe Ritter

Unclassified

Printable Spacecraft: Flexible Electronic Platforms for NASA Missions

Kendra Short, NASA Jet Propulsion Laboratory



Description

Flexible printed electronics is a wide-ranging technology that can enhance many engineering applications. Our concept is to utilize the commercial technology of printed electronics to design and fabricate an entire end to end functional spacecraft. The novel advancement of the concept is to apply printed electronics in a multi-functional platform by implementing every subsystem that a spacecraft might need from the scientific sensor through the data downlink and have it survive and function in a space environment. These requirements push the current state of the art for functionality as well as introduce design and manufacturing compatibility challenges among the functional subsystems. Current industry growth and commercial investment is expected to advance the functionality of available basic building blocks and components synergistically with NASA's needs.

Environmental survivability, unique sensors and mission implementation will be NASA's challenge. In Phase 1 of our NIAC task entitled "Printable Spacecraft", we investigated the viability of printed electronics technologies for creating multi-functional spacecraft platforms. We also explored mission concepts and architectures that may be enhanced or enabled with this technology.

The proposed Phase II study of the Printable Spacecraft is a direct continuation of Phase I comprised of five focused tasks. First, we will address technical feasibility through design and fabrication of a bench top prototype of a printed spacecraft. Second, we will perform testing on printed components to understand environmental compatibility. Third, programmatic feasibility will be established through a focused cost/benefit assessment for a single mission. Fourth, we will continue to validate the programmatic benefits of a printed spacecraft by expanding the study of a variety of mission applications. Lastly, we will define the technology development paths that can be taken including key technology milestones and follow on opportunities for demonstrations. Continuing with the JPL team from Phase 1, we have augmented it with two critical industry partners who are key players in the printed electronics field: Xerox PARC and Boeing Research and Technology.

Industry Partners in printed electronics: Xerox PARC, Boeing Research & Technology



Atmospheric confetti - Inchworm crawlers - Blankets of ground penetrating radar

These are some of the unique mission concepts which are enabled by a printable spacecraft.

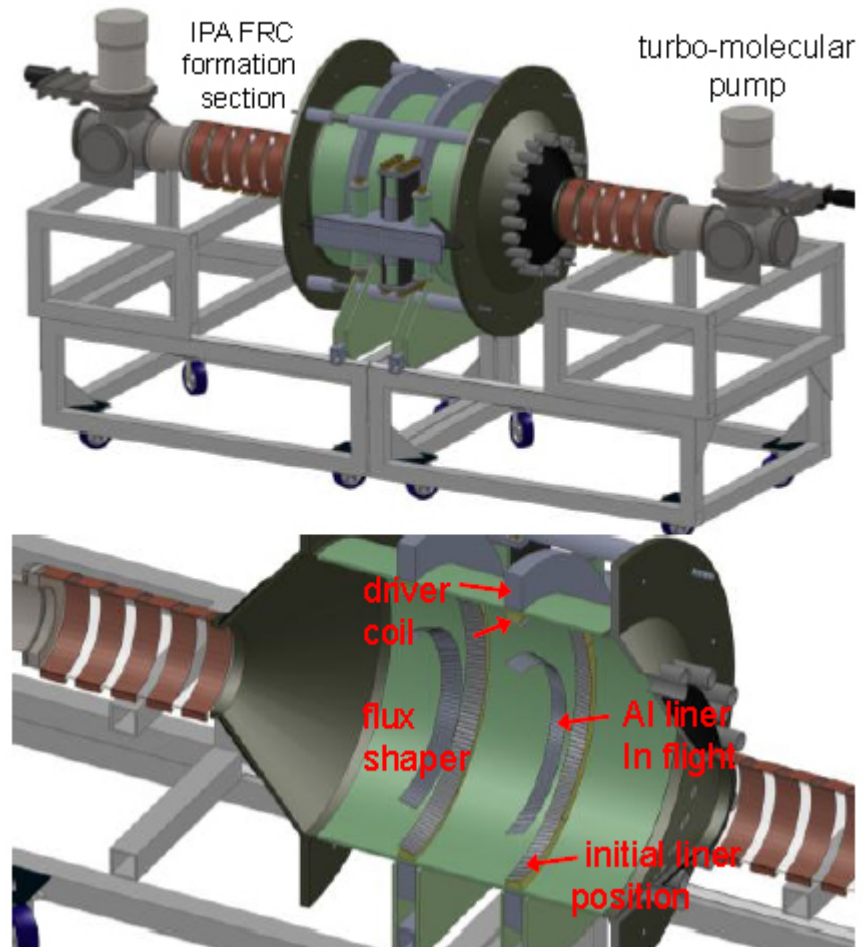
The Fusion Driven Rocket: Nuclear Propulsion through Direct Conversion of Fusion Energy

John Slough, University of Washington



Description

The future of manned space exploration and development of space depends critically on the creation of a dramatically more proficient propulsion architecture for in-space transportation. A very persuasive reason for investigating the applicability of nuclear power in rockets is the vast energy density gain of nuclear fuel when compared to chemical combustion energy. Current nuclear fusion efforts have focused on the generation of electric grid power and are wholly inappropriate for space transportation as the application of a reactor based fusion-electric system creates a colossal mass and heat rejection problem for space application. The Fusion Driven rocket (FDR) represents a revolutionary approach to fusion propulsion where the power source releases its energy directly into the propellant, not requiring conversion to electricity. It employs a solid lithium propellant that requires no significant tankage mass. The propellant is rapidly heated and accelerated to high exhaust velocity (> 30 km/s), while having no significant physical interaction with the spacecraft thereby avoiding damage to the rocket and limiting both the thermal heat load and radiator mass.



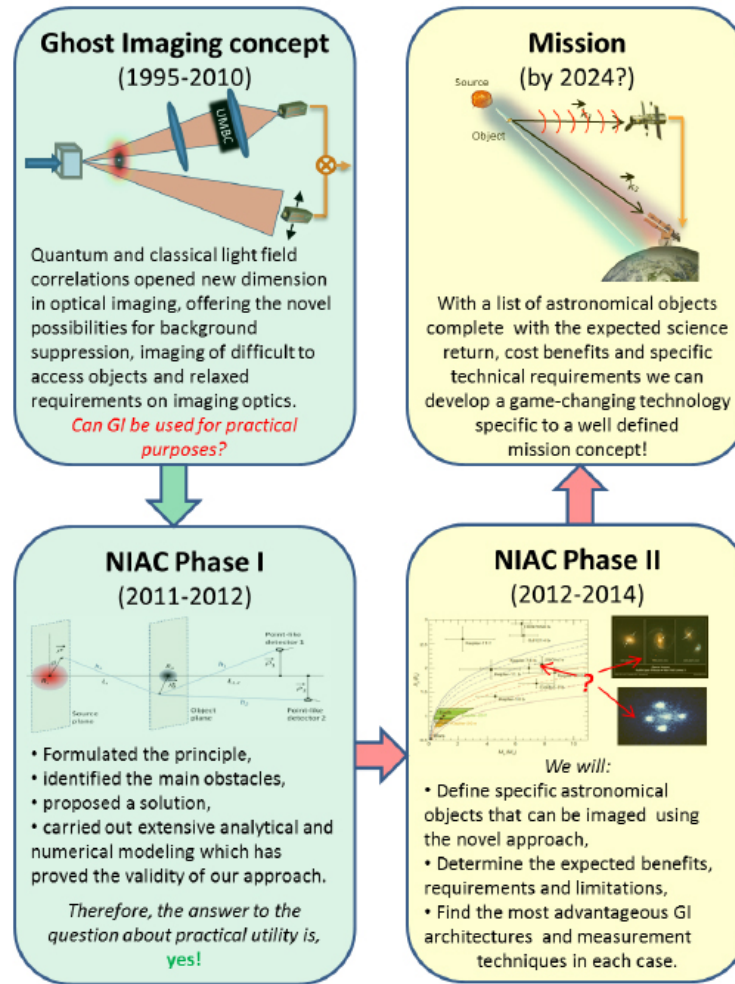
Ghost Imaging of Space Objects

Dmitry Strekalov, NASA JPL



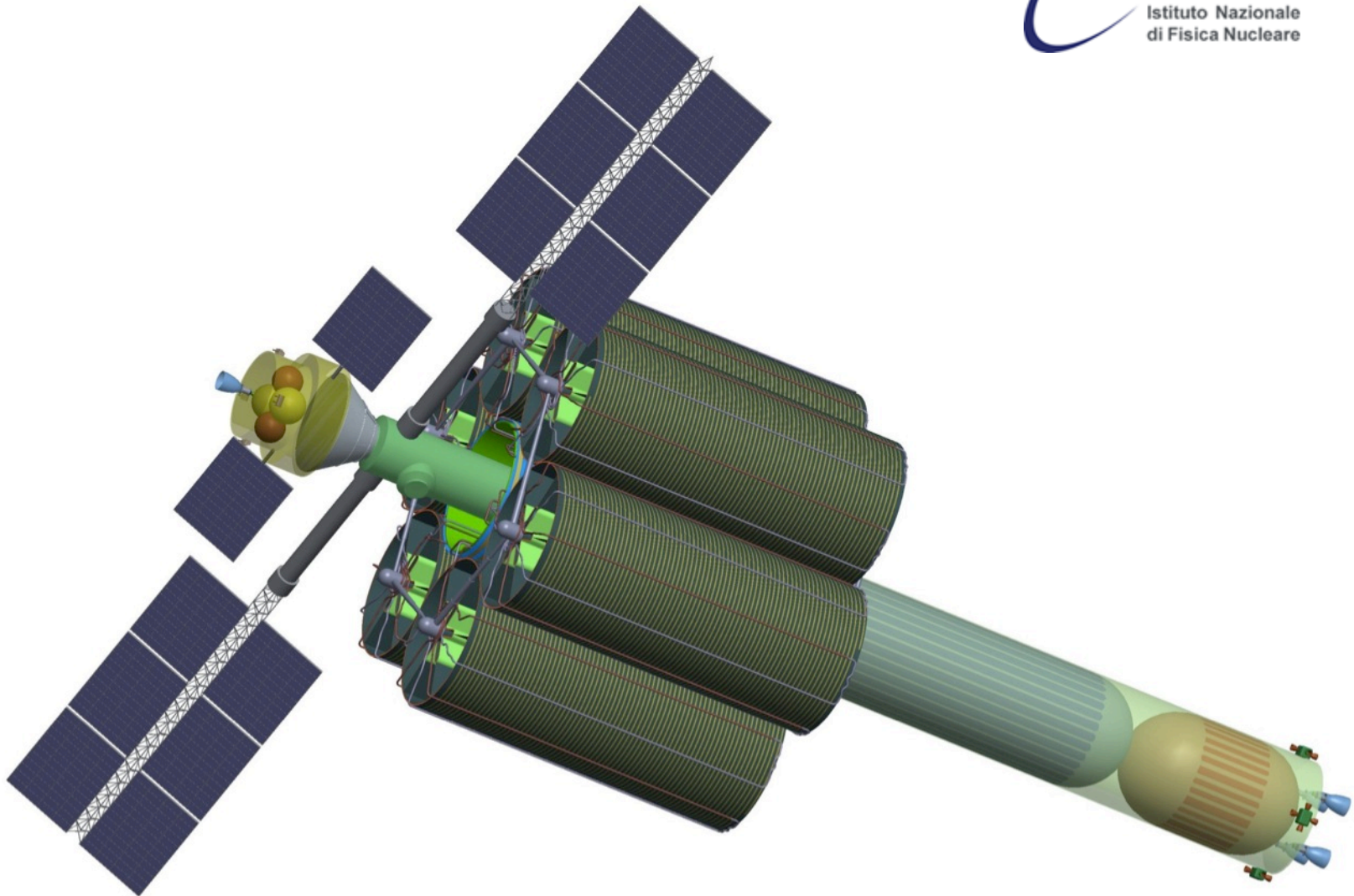
Description

The NIAC research effort entitled “The Ghost Imaging of Space Objects” has been inspired by the original 1995 Ghost Imaging and Ghost Diffraction experiments that harnessed quantum-correlated photons to recover an object’s image from a measurement lacking spatial resolution, but utilizing an empty reference channel. Various applications of this phenomenon have been soon proposed, ranging from the optical imaging exceeding the classical resolution limit (Rayleigh limit), to the ultimately secure quantum communications and super-dense signal encoding. It was also realized, around 2004-5, that not only quantum-correlated but even a common thermal source of light can be used for the Ghost Imaging, although at a cost of a reduced contrast. Since then, the possibility of ghost-imaging of space objects has been intriguing many physicists. Unfortunately, the need for an optical beam splitter to be placed between the thermal light source (e.g., a star), the object and the observer severely diminished the practical value of this idea.





MAARSS





Cavehopping Exploration of Planetary Skylights and Tunnels

William Whittaker, Astrobotic Technology, Inc.

Description

Subsurface caverns may be the best place on Mars to find life. They may be the best hope for safe havens and habitation on the Moon. They can provide a window into a planet's geology, climate, and even biology. Skylights, formed by partial cave ceiling collapse, provide access to subsurface voids. Tunnel entrances have been conclusively shown to exist on Mars and the Moon. There is also evidence supporting their existence on other planetary bodies throughout the solar system. Despite astonishing discoveries of skylights and cave entrances, and their inevitable exploration, they do not yet appear in the decadal survey. Skylights and the voids below are so unknown that it is too risky to send astronauts to explore them without prior robotic reconnaissance and modeling. While robotic exploration of skylights and caves can seek out life, investigate geology and origins, and open the subsurface of other worlds to humankind, it is a daunting venture. Planetary voids present challenging terrain that requires innovative technologies for access, exploration, and modeling. The robots that venture into caves must leap, fly, or rappel into voids, traverse rubble, navigate safely in the dark, self-power, and explore autonomously with little or no communication to Earth. Exploiting these features necessitates a "leap" of technology from current planetary missions, which land with large error ellipses in statistically safe terrain, rove slowly and cautiously across the surface, depend on the sun for power and light, and rely heavily on human commands.

Team combines space robotics expertise of Astrobotic Technology with expertise in subsurface modeling and autonomy from Carnegie Mellon University. The program details subsurface mission architecture and develops a technology roadmap to bring missions with this architecture to flight. Three key enabling technologies are advanced to TRL 3: robot configuration for mobility and sensing, subsurface terrain modeling, and in-cave autonomy.

Partnership with Carnegie Mellon University

Cavehopping Exploration of Planetary Skylights and Tunnels

ASTROBOTIC

PI: William "Red" Whittaker

Motivation

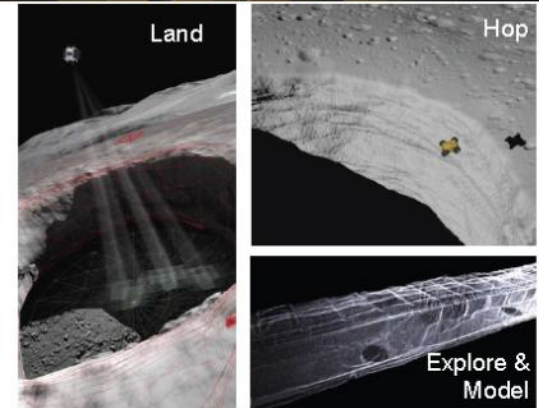
Subsurface caverns may be the best place on Mars to find life. They may be the best hope for safe havens and habitation on the Moon. They can provide a window into a planet's geology, climate, and even biology. Skylights, formed by partial cave ceiling collapse, provide access to subsurface voids. Tunnel entrances are conclusively shown to exist on Mars and the Moon and evidence suggests their existence on other planetary bodies. Despite astonishing discoveries of skylights and cave entrances, they do not yet appear in the decadal survey.

Robotic exploration of skylights and caves can seek out life, investigate geology and origins, and open the subsurface of other worlds to humankind. However, exploration of these features is a daunting venture. Planetary voids present perilous terrain that requires innovative technologies for access, exploration, and modeling.

Approach

Phase II develops subsurface mission architectures and enabling technologies to explore and model subsurface voids. The key technology innovation is development of "Cavehoppers", hybrid driving/hopping robots for efficient and effective exploration and modeling of planetary subsurface environments. Phase II will innovate technologies for:

- Subsurface robot mobility and sensing configuration;
- Sensing and modeling in darkness from a lightweight, dynamic platform with commodity sensing; and
- Autonomy for safe exploration and model building with hopping robots.



Team, Cost, & Proposed Work

- Team combines space robotics expertise of Astrobotic Technology with expertise in subsurface modeling and autonomy from Carnegie Mellon University.
- Cost for the two-year program is \$498,411.
- The program details subsurface mission architecture and technology roadmap to achieve them.
- Three key enabling technologies are advanced to TRL 3: mobility and sensing configuration, modeling, and autonomy.



Planetary subsurface voids may be the best place to seek out life, find safe havens for humans, and investigate planetary geology. Astrobotic proposes technologies and missions to unlock these voids.

An Innovative Solution to NASA's NEO Impact Threat Mitigation Grand Challenge & Flight Validation Mission Design

Bong Wie (NIAC Phase 2 Fellow), Iowa State University

Brent Barbee (Co-I), NASA Goddard Space Flight Center

A near miss by asteroid 2012 DA14 (45 m) on Feb. 15
(An airburst of Russian 17-m meteor on the same day)

If an impact by DA14 did happen, its impact damage:
160 Hiroshima nuclear bombs or 2.4 Mt of TNT

A \$500M space mission being evaluated through a NIAC Phase 2 study
will be able to mitigate such impact threat with a short warning time



BREAK



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MARC COHEN





DAVID KIRTLEY





LUNCH



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SPECIAL ADDRESS

BRYAN WUNAR

**Chicago Museum of
Science & Industry**

**“Education and Public Outreach:
Inspiring the Next Generation”**



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GEOFFREY LANDIS



JOSEPH PREDINA



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ROBERT HOYT

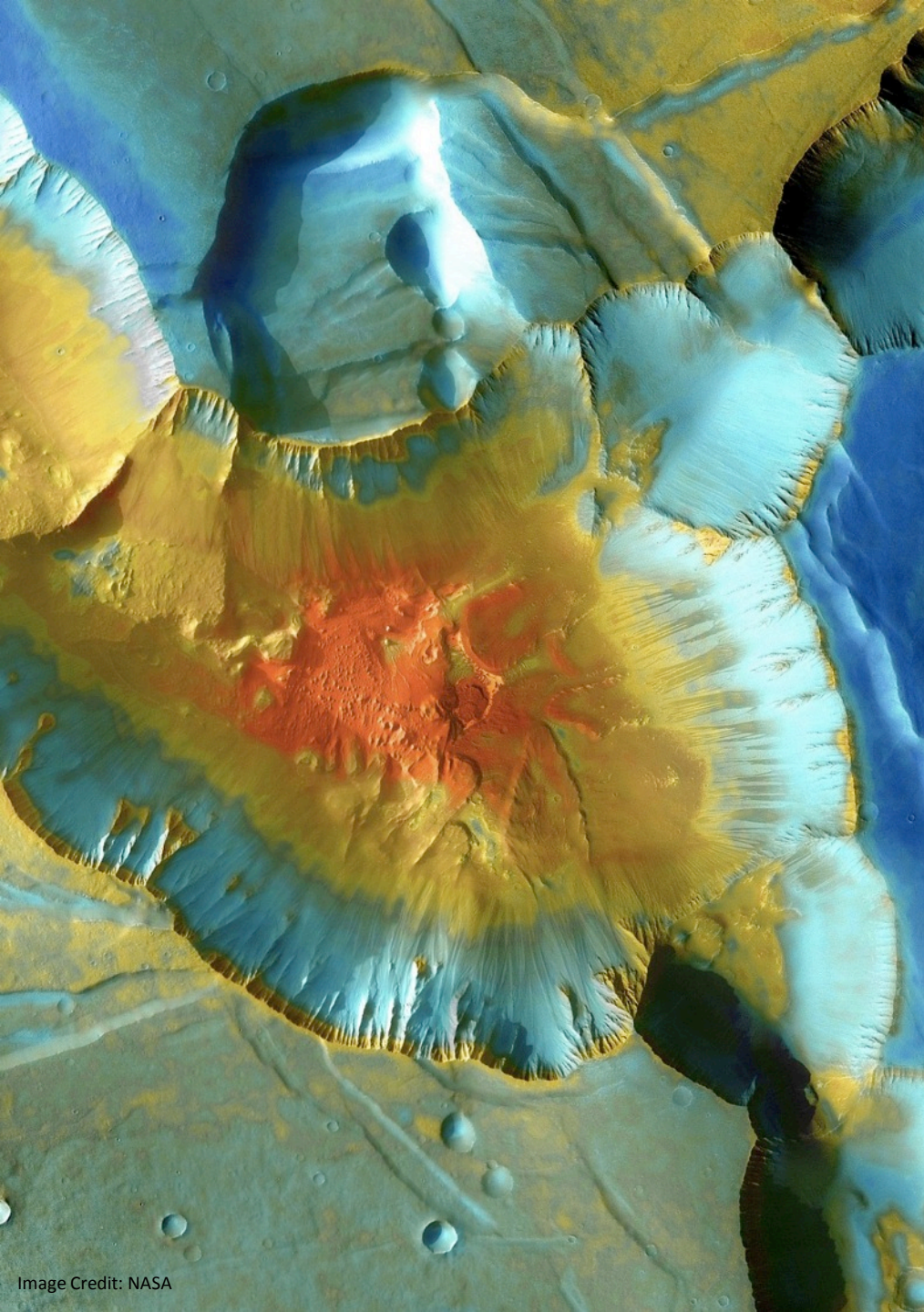




BABAK SAIF



JEFFREY NOSANOV



POSTER SESSION I:

2012 NIAC PHASE II FELLOWS

Room CC12B



Adjourn

Symposium Resumes 9:00am Wed



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What is **NIAC**?

NASA Innovative Advanced Concepts

NASA Innovative Advanced Concepts

A program to support
early studies of
innovative, yet credible,
visionary concepts
that could one day
“change the possible”
in aerospace.



NIAC Awards, Scope, Criteria

- NIAC awards support 2 phases of study:
 - **Phase I:** up to \$100K, ~9 months, for concept definition and initial analysis in a mission context
 - **Phase II:** up to \$500K, 2 years, for further development of most promising Phase I concepts, comparative mission analysis, pathways forward
- Scope of NIAC Phase I Studies:
 - Aerospace **architecture, mission, or system** concepts (not focused tech.)
 - **Exciting:** offering a potential breakthrough or revolutionary improvement
 - **Unexplored:** novel, with basic feasibility and properties unclear
 - **Credible:** sound scientific/engineering basis and plausible implementation
- NIAC proposal evaluation criteria:
 - **Potential of the Concept** (all scope elements above, especially exciting)
 - **Strength of the Approach** (research objectives, technical issues, suitability of team and cost)
 - **Benefits of the Study** (concept definition, mission analysis, wider benefits, scientific/engineering contributions, notably new/different/inspiring)

Day 2 Outline



9:00 Commence

- **NIAC Plans & Announcements**
- **Special Address: *Bob Cassanova, NIAC External Council***

10:00 – 10:30 Break

- **Two Phase I Presentations**
- **Special Address: *Geza Gyuk, Adler Planetarium***
- **Special Address: *Kazuhiko Yotsumoto, JAXA Innovation Study Team***

12:00 – 1:30 Lunch

- **Two Phase I Presentations**

2:30 – 3:00 Break

- **Three Phase I Presentations**
- **4:30 Poster Session II & Ad Hoc Discussions**

5:30 Adjourn



NIAC Plans & Announcements



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NIAC's parent
organization has
a new name:

**Space Technology
Mission Directorate**

www.nasa.gov/spacetech

Space Technology Mission Directorate



Announced February 21, 2013:

With successful formulation and implementation of Space Technology program, NASA officially separates Office of the Chief Technologist (OCT) into two organizations: OCT and Space Technology Mission Directorate.

Office of the Chief Technologist

- Continues to serve as the Administrator's principal advisor and advocate on matters concerning Agency-wide technology policy and programs;
- Continues to lead NASA's technology transfer and commercialization efforts;
- Integrates, tracks, and coordinates all of NASA's technology investments; and
- Documents and communicates the societal impacts of the Agency's technology efforts.

Space Technology Mission Directorate

- Has direct management and budget authority of the Space Technology programs, which are performed by all 10 NASA Centers;
- Focuses on project execution and technology infusion into the Agency's exploration and science mission needs;
- Takes a customer driven approach, proving capabilities needed for future NASA missions and the national aerospace community; and
- Develops the Nation's innovation economy.

Realignment will not affect the mission, content or budget authority of the Space Technology Programs.

Space Technology Programs



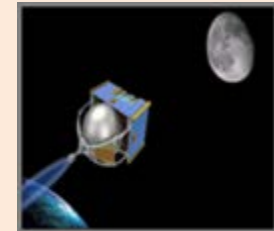
Transformative &
Crosscutting
Technology
Breakthroughs



**Game Changing
Development Program**



**Technology
Demonstration
Missions Program**



**Small Spacecraft
Technologies Program**

Pioneering Concepts/
Developing
Innovation
Community



**Space Technology
Research Grant Program**



**NASA Innovative
Advanced Concepts
(NIAC) Program**



**Center Innovation Fund
Program**

Creating Markets &
Growing Innovation
Economy



**Centennial Challenges
Prize Program**



**Small Business Innovation Research
& Small Business Technology
Transfer (SBIR/STTR) Program**



**Flight Opportunities
Program**

NASA's Technology Portfolio



National Science and Technology Priorities

Top Down Driven Strategic Guidance



National Aeronautics Research and Development Plan

External Technology Portfolios & Partnerships



Mission Directorate Requirements



ARM D



HEOM D



SMD



SMD



HEOM D



STMD



ARM D

Technology Portfolio

Bottom Up Driven Requirements

NASA's Space Technology Portfolio



2010

Space Technology Roadmaps

- 140 challenges (10 per roadmap)
- 320 technologies
- 20-year horizon



2011

National Research Council (NRC) Study

Prioritization:

- 100 top technical challenges
- 83 high-priority technologies (roadmap-specific)
- 16 highest of high technologies (looking across all roadmaps)



2012

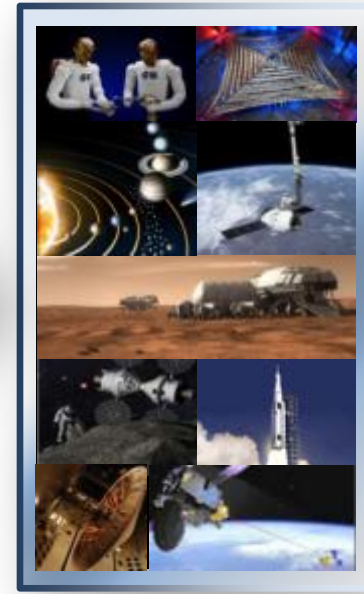
SSTIP

Updated ST Roadmaps:

- Incorporate NRC Study Results

Developing a Strategic Space Technology Investment Plan:

- current investments
- current MD/Office priorities
- opportunities for partnership
- gaps vs. current budget and capabilities
- 20-Year horizon with 4-year implementation cadence

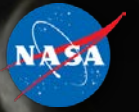


Execution

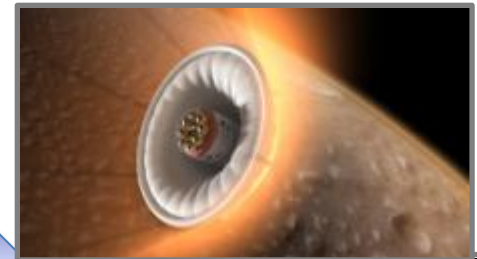
Investment Portfolio

- Technology Developments (across full Technology Readiness Level (TRL) spectrum)
- Flight Demonstrations
- Must accommodate:
 - Mission Needs
 - Push Opportunities
 - Affordability
 - Technical Progress
 - Programmatic Performance
 - Commitments
- Budgeted annually

Space Tech: Investments in Our Future



- **Enabling Our Future in Space:** By investing in high payoff, disruptive technology that industry cannot tackle today, *Space Technology* matures the technology required for NASA's future missions in science and exploration while proving the capabilities and lowering the cost for other government agencies and commercial space activities.
- **NASA at the Cutting Edge:** Pushing the boundaries of aerospace technology and seizing opportunities, *Space Technology* allows NASA and our Nation to remain at the cutting edge.

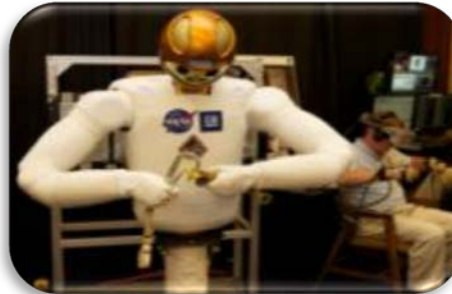
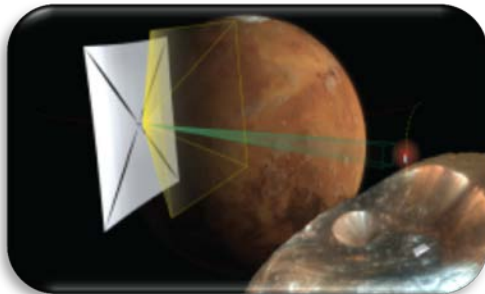


Space Technology Guiding Principles



Space Technology Program

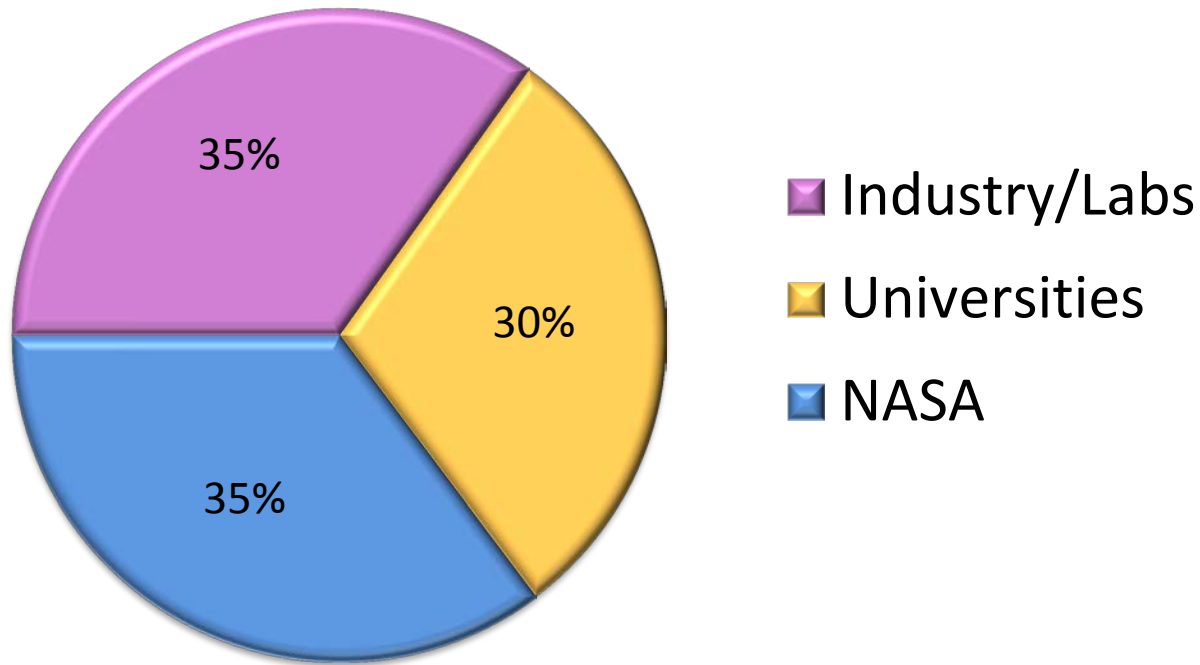
- **Adheres to a Stakeholder Based Investment Strategy:** NASA Strategic Plan, NASA Space Technology Roadmaps / NRC Report and Strategic Space Technology Investment Plan
- **Invests in a Comprehensive Portfolio:** Covers low to high TRL, student fellowships, grants, prize competitions, prototype developments, and technology demonstrations
- **Advances Transformative and Crosscutting Technologies:** Enabling or broadly applicable technologies with direct infusion into future missions
- **Selects Using Merit Based Competition:** Research, innovation and technology maturation open to academia, industry, NASA centers and other government agencies
- **Executes with Structured Projects:** Clear start and end dates, defined budgets and schedules, established milestones, and project authority and accountability.
- **Infuses Rapidly or Fails Fast:** Rapid cadence of technology maturation and infusion, informed risk tolerance to infuse as quickly as possible
- **Positions NASA at the cutting edge of technology:** Results in new inventions, enables new capabilities and creates a pipeline of innovators for National needs



NIAC Award Distribution



NIAC Awards to Date (2011-2012) by Organization Type of Lead Proposer *



* At point of selection. Does not reflect changes, nor splits within mixed study teams.

Key 2013 Dates

- New FY13 Awards
 - Ph.I: Announce late July, award by mid-Aug
 - Ph.II: Announce late Aug, award by mid-Sept

- Phase II Site Visits: Sept-Oct 2013
 - Official mid-study review for Ph.II studies
 - Exact timing & venues TBD

- Fall Symposium: early November, venue TBD
 - Orientation for new studies
 - Emphasis on new Phase II presentations

FY13 Still On Schedule

NASA Research Announcements	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
PHASE I	1 Proposal Development 1) 1/15 Phase I NRA Released 2) 2/14 Step A Proposals Due 3) 3/20 Step B Invitations Sent 4) 4/18 Step B Proposals Due	2	3 NIAC Spring Symposium (March 12-14)	4 5 Independent Review 5) Screen Complete 6) Review Panels 5/13-31 7) Integration Panel by 6/20	6	7 8 NASA Prioritization 8) NASA HQ Review by 7/5 9) OCT Rec. Panel 10) SSO Review	9 10 11 Award 11) Announce Selections 7/18 12) Awards Received NLT 8/15	12	
PHASE II					1 Proposal Devt. 1) Phase II NRA 5/22 Responses due 7/2	2 Independent Review 3) e-Reviews by 8/2 4) Integration Panel by 8/8	3 4 5 NASA Prior. 5) NASA HQ Review 8/16	6 Award 6) Announce Selections 8/23 7) Awards 9/23	7

Key 2013 Dates: Phase I Details

- Two-Step Solicitation / Response: Jan - April
 - NASA Research Announcement (NRA) released Jan 15
 - Step A White Papers due Feb 14 (1 month)
 - **Step B invitations out by March 20** (1 month)
 - Step B **Full Proposals due Apr 18** (1 month)
- Review Panels: April - June
 - Technical Review Panels complete by late May
 - Integration Panel complete by late June
- HQ Review & Announcements: July
 - Consultation for synergy/overlap with other NASA efforts
 - Official Source Selection by mid-late July
 - Announcement ASAP (all proposers receive notification)
- Goal: all awards received by mid-August
 - These will be for 9-month studies, up to \$100K

Key 2013 Dates: Phase II Details

- One-Step Solicitation / Response: May - July
 - NASA Research Announcement (NRA) release late May
 - Full Proposals due early July (6 weeks)*
 - * Only eligible if Phase I Final Report is received
- Review Process: July - August
 - Technical Reviews complete by early Aug
 - Integration Panel complete by mid Aug
- HQ Review & Announcements: July
 - Consultation for synergy/overlap with other NASA efforts
 - Official Source Selection by late Aug
 - Announcement ASAP (all proposers receive notification)
- Goal: all awards received by mid-September
 - These will be for 2-year studies, up to \$500K



Recognizing Dr. Robert Cassanova

Founding NIAC Director
NIAC External Council Chair



NIAC Founding Philosophy

Visionaries and geniuses share common traits:

The ability to transcend life's experiences
and leap vast intellectual distances
to set a new course for others to follow.

Imagination and visualization are generally the first
step in learning, or creating, something radically new.

**Genius is the ability to transcend experience
and "The Rules"**

*"You cannot depend on your eyes when your
imagination is out of focus" -- Mark Twain*







SPECIAL ADDRESS

BOB CASSANOVA

NIAC External Council Chair



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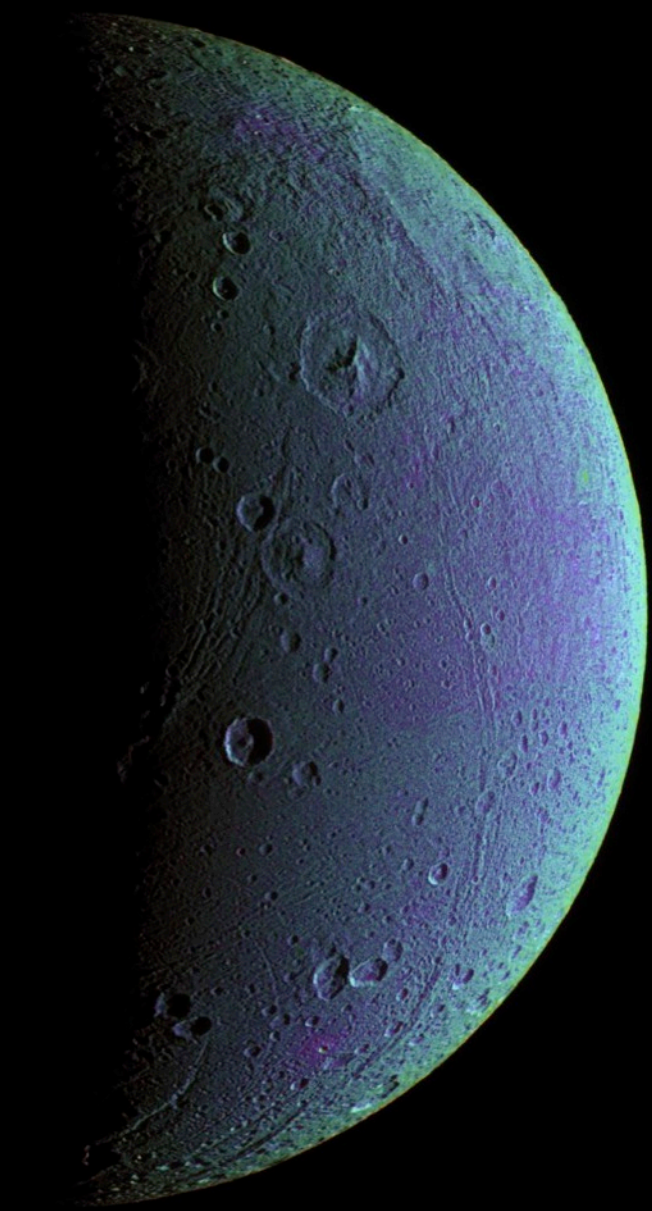
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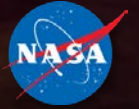
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WAYNE GELLETT



GECHENG ZHA



SPECIAL ADDRESS

GEZA GYUK

Adler Planetarium

**“Far Horizons: Democratizing Space
Exploration from High Altitude
Balloons to Asteroid Missions”**



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SPECIAL ADDRESS

KAZUHIKO YOTSUMOTO

**Japan Aerospace Exploration
Agency (JAXA)**

**“JAXA’s Activity on
New Concept Creation”**



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ADRIAN AGOGINO





MICHAEL FLYNN





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LEIGH McCUE

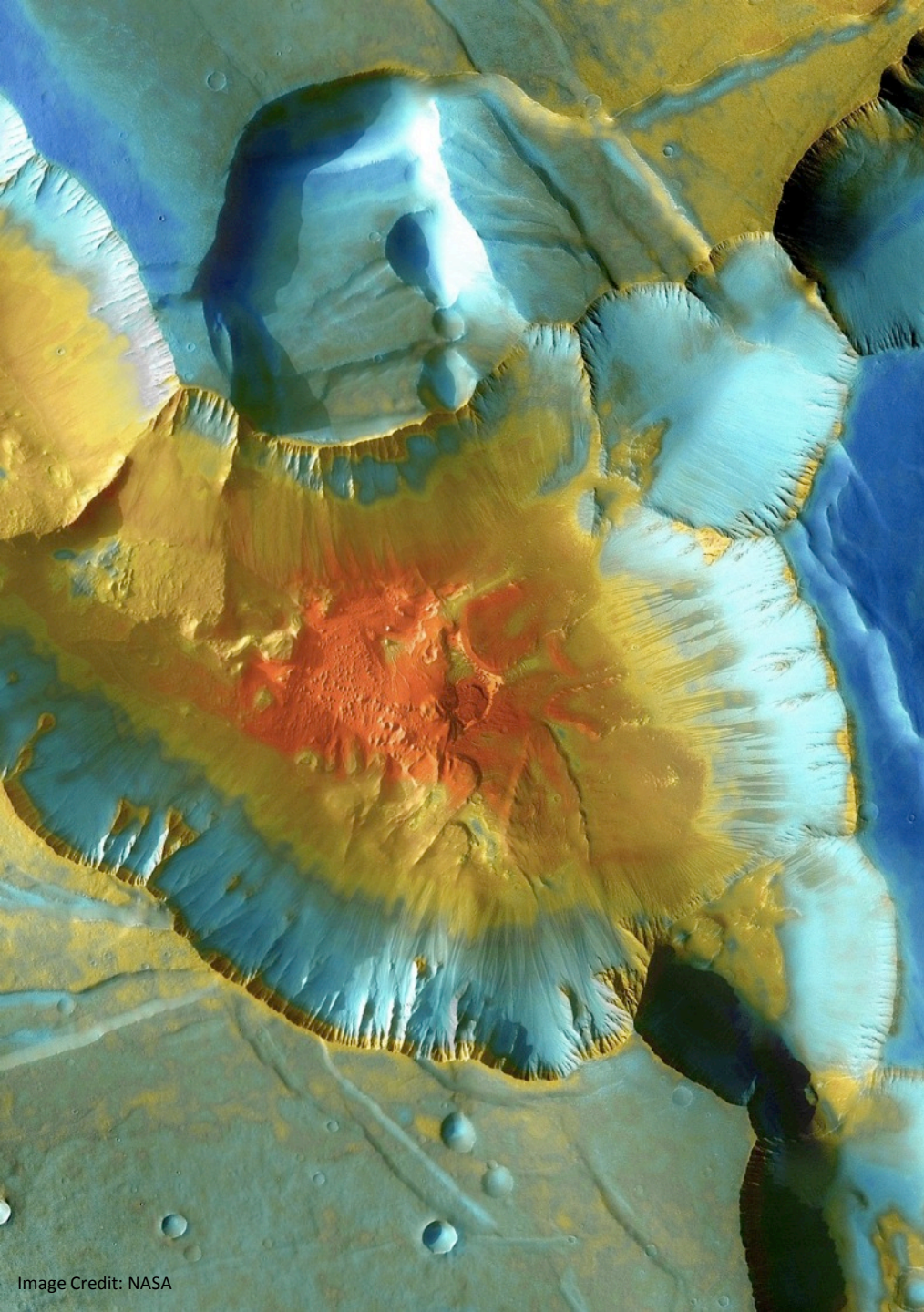


ROBERT HOYT





THOMAS DITTO



**POSTER
SESSION II
& AD HOC
DISCUSSIONS:**

**2012 NIAC
PHASE II
FELLOWS**

Room CC12B



Adjourn

Symposium Resumes 9:00am Thurs



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